Power Supply Test Station

PSTS

R & M

OCT 85

SWINGER TWO™

USERS' MANUAL

INSTRUMENT DIVISION

1289 Hammerwood Avenue
Sunnyvale, CA 94086
(408) 734-5970

3H INDUSTRIES

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INDUSTRIES

WARRANTY

3H Industries warrants this Swinger Two™ electronic load to be free from defects caused by faulty material or poor workmanship for a period of six months after shipment. During the warranty period, any unit found to be defective will be repaired or replaced without charge for service or materials if the unit is returned, freight prepaid, to the factory or service center designated by 3H Industries. Returns must have a Return Material Authorization number assigned prior to shipment.

The foregoing warranty shall not apply to products which 3H Industries determines have been subjected to operating and/or environmental conditions in excess of the maximum values therefore in the applicable specifications or otherwise have been subjected to misuses, neglect, or unauthorized installation or repair, and does not extend to expendable items such as lamps, fuses, or the like, or to mechanical parts which fail from normal usage.

3H Industries reserves the right to change the design of the Swinger Two™ at any time without incurring any obligation to install these changes on previously purchased units.

This warranty is expressed in lieu of all other warranties or representations, expressed, implied or statutory including the implied warranties of fitness for a particular purpose or merchantability. In no event shall 3H Industries be liable for any incidental, consequential or special damages.

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1.1 INTRODUCTION

Swinger Two™ Model is a floating electronic load for testing DC sources in both static and dynamic conditions. The Swinger Two™ has multiple current ranges and measuring voltage range covering a span from 600 milliamps to 300 Amps full scale with power handling capabilities up to 2500 watts. Operating voltages range from 1 volt to 150 volts. Swinger Two™ may be operated in either constant current or constant resistance modes.

For incorporation into automatic test or burn in systems, all functions can be controlled from an IEEE bus. In benchtop operation, a front panel keyboard and display allow the user to define the desired load (including its slew rate) and to measure conditions with single keystrokes.

In the dynamic mode, for example, the alphanumeric display will automatically scroll through a setup procedure by asking the user to key in the desired parameters such as high current level, low current level, high current time duration, low current time duration, and the independant slew rates of both rise time and fall time. Up to two complete waveforms (WAVE 1 and WAVE 2) may be stored for instant recall for the loading function. There is also a dual function that when programmed will cause the load to continuously alternate between the two waveforms. A slew mode with up and down keys also allows the user to vary any of the parameters continuously or in small discrete steps while applying the load.

Multi-range measurement of current, voltage(with remote sensing), and dynamic load regulation are rapidly and precisely made and displayed using an internal 12-bit A/D converter and microprocessor. Dynamic load regulation is calculated from voltage measurements at both high and low current levels and then displayed.

For reliable long-life operation, Swinger Two™ is protected against reverse voltage, over-voltage, over-power, and over-temperature. In addition, the output stage is optically isolated from the control section (including the IEEE control), providing a true floating load.

All of the above features plus self-test, error indicating messages, and ease of operation make Swinger Two™ a simple to operate and, yet, a powerful instrument!

1.2 DIMENSIONS

See Table 1 for your model.

1.3 SPECIFICATIONS

GENERAL

See Table 2 for your model.

1.4 OPERATING REGIONS

The operating region for the Swinger Two™ Models are shown in Figures 1a-1f. As stated in the specifications, the operating contour is bounded by voltage levels and current levels. These bounds apply to both static and dynamic operation of the Swinger Two™.

Please note the following:

1. The lower limit of the operating voltage range is 3 volts for operation at the maximum current level. For lower currents, this limit is adjusted approximately as shown in the following graph:

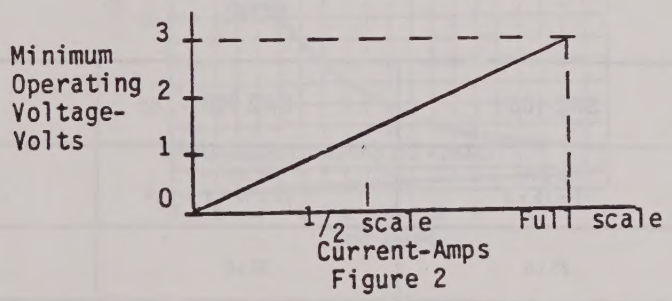


Figure 2

2. For extended reliability and life, power levels of 80% of maximum are recommended for operation at more than 40V on the 50V models and 120V on the 150V models.

3. The power limiting circuit limits operation to approximately the full scale power range of your Swinger Two™. The Power Over Range Indicator will flash on the alphanumeric display when this circuit is active. To resume operation, reduce either the voltage or current and press the run key or reset the load through the IEEE bus.

1.2 DIMENSIONS

PARAMETER	MODEL		
	SW2-20	SW2-20HV	SW2-50
SIZE	W D H 9"×18"×6¾"	W D H 9"×18"×6¾"	W D H 9"×18"×6¾"
WEIGHT	12 LB	12 LB	15 LB

PARAMETER	MODEL		
	SW2-100	SW2-200	SW2-300
SIZE	W D H 17 x 15 x 7	W D H 17 x 17 x 7	W D H 17 x 17 x 10½
WEIGHT	25 LB.	32 LB	47 LB

Table 1

OPERATING REGION

Figure 1a.

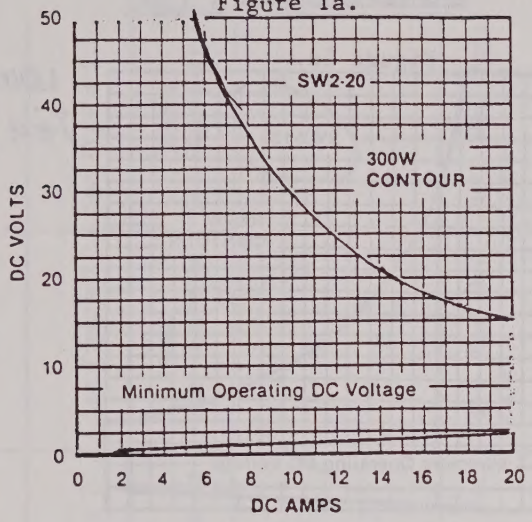


Figure 1b.

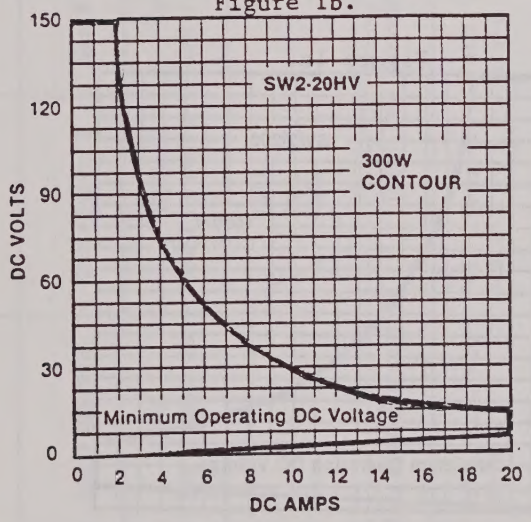
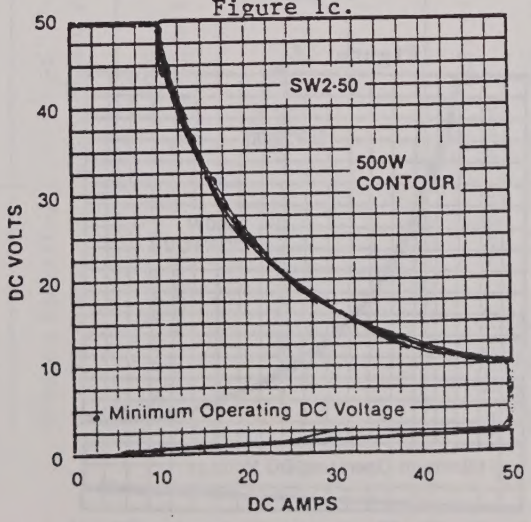
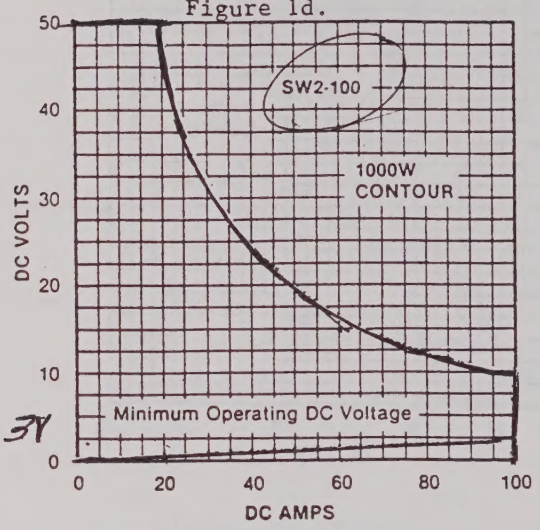


Figure 1c.



OPERATING REGION

Figure 1d.



LOWER LIMIT = 3 VOLTS FOR MAX CURRENT OPERATION

MIN = 3V

Figure 1e.

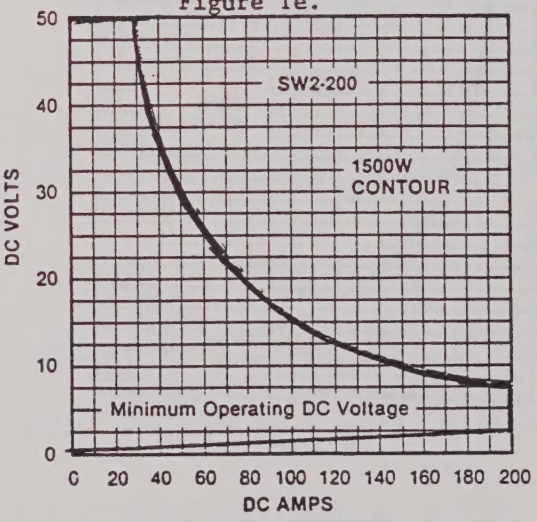


Figure 1f.

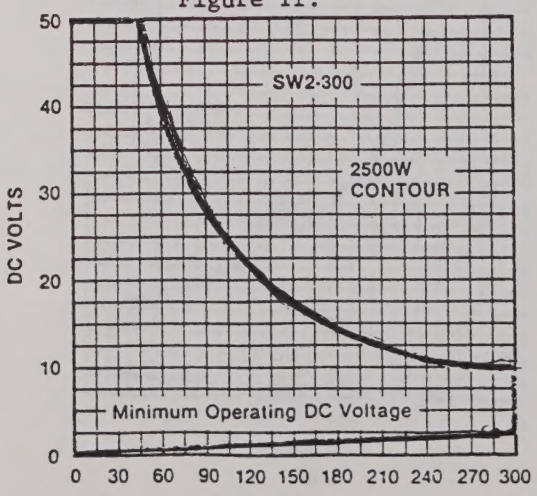


TABLE 2 (SPECIFICATIONS)

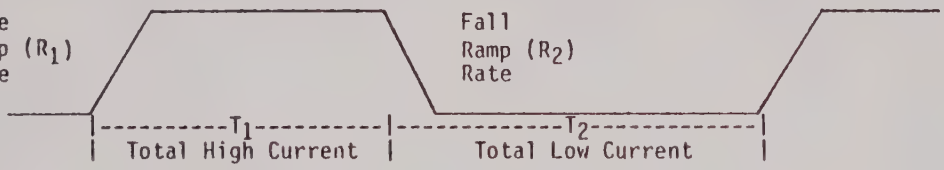
PARAMETER	MODEL SW2-20	SW2-20HV	SW2-50	SW2-100	SW2-200	SW2-300
Maximum Current	20A	20A	50A	100A	200A	300A
Maximum Operating Voltage	60V	150V	50V	50V	50V	50V
Minimum Operating Voltage	See Figure 2	See Figure 2	See Figure 2	See Figure 2	See Figure 2	See Figure 2
Maximum Continuous Power	300W See Figure 1a	300W See Figure 1b	500W See Figure 1c	1000W See Figure 1d	1500W See Figure 1e	2500W See Figure 1f
Current Waveform Definition						
Full Scale (Range) Current (Constant Current or Resistive Mode) 1	Full Scale 2A; Res. 2mA; Acc. 1%+20mA	Full Scale 2A; Res. 2mA; Acc. 1%+20mA	Full Scale 5A; Res. 5mA; Acc. 1%+30mA	Full Scale 10A; Res. 10mA; Acc. 1%+50mA	Full Scale 20A; Res. 20mA; Acc. 1%+100mA	Full Scale 30A; Res. 30mA; Acc. 1%+200mA
2	Full Scale 20A; Res. 20mA; Acc. 1%+50mA	Full Scale 20A; Res. 20mA; Acc. 1%+50mA	Full Scale 50A; Res. 50mA; Acc. 1%+100mA	Full Scale 100A; Res. 100mA; Acc. 1%+200mA	Full Scale 200A; Res. 200mA; Acc. 1%+400mA	Full Scale 300A; Res. 300mA; Acc. 1%+600mA
High Current Level Duration (T_1) (See Note 1)	Range 10 mSec.; Res. 0.5 uSec; Acc. 0.2%+1 uSec.	Range 10 mSec.; Res. 0.5 uSec; Acc. 0.2%+1 uSec.	Range 10 mSec.; Res. 0.5 uSec; Acc. 0.2%+1 uSec.	Range 10 mSec.; Res. 0.5 uSec; Acc. 0.2%+1 uSec.	Range 10 mSec.; Res. 0.5 uSec; Acc. 0.2%+1 uSec.	Range 10 mSec.; Res. 0.5 uSec; Acc. 0.2%+1 uSec.
Low Current Level Duration (T_2) (See Note 2)	Range 10 mSec.; Res. 0.5 uSec; Acc. 0.2%+1 uSec.	Range 10 mSec.; Res. 0.5 uSec; Acc. 0.2%+1 uSec.	Range 10 mSec.; Res. 0.5 uSec; Acc. 0.2%+1 uSec.	Range 10 mSec.; Res. 0.5 uSec; Acc. 0.2%+1 uSec.	Range 10 mSec.; Res. 0.5 uSec; Acc. 0.2%+1 uSec.	Range 10 mSec.; Res. 0.5 uSec; Acc. 0.2%+1 uSec.

TABLE 2 (SPECIFICATIONS)

PARAMETER	MODEL SW2-20	SW2-20HV	SW2-50	SW2-100	SW2-200	SW2-300
Rise Ramp Rate (R_1)	Range Res. Acc. 1A/ uSec. 2mA/ 1% to uSec. 2mA/ uSec.	Range Res. Acc. 1A/ uSec. 2mA/ 1% to uSec. 2mA/ uSec.	Range Res. Acc. 2.5A/ uSec. 5mA/ 1% to uSec. 5mA/ uSec.	Range Res. Acc. 5A/ uSec. 10mA/ 1% to uSec. 10mA/ uSec.	Range Res. Acc. 10A/ uSec. 20mA/ 1% to uSec. 20mA/ uSec.	Range Res. Acc. 15A/ uSec. 30mA/ 1% to uSec. 30mA/ uSec.
Fall Ramp Rate (R_2)	Range Res. Acc. 1A/ uSec. 2mA/ 1% to uSec. 2mA/ uSec.	Range Res. Acc. 1A/ uSec. 2mA/ 1% to uSec. 2mA/ uSec.	Range Res. Acc. 2.5A/ uSec. 5mA/ 1% to uSec. 5mA/ uSec.	Range Res. Acc. 5A/ uSec. 10mA/ 1% to uSec. 10mA/ uSec.	Range Res. Acc. 10A/ uSec. 20mA/ 1% to uSec. 20mA/ uSec.	Range Res. Acc. 15A/ uSec. 30mA/ 1% to uSec. 30mA/ uSec.
Overshoot (Pos. or Neg.)	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Voltage Measure — Range 1	6V	6V	6V	6V	6V	6V
Voltage Measure — Range 2	20V, 0.3%+ .1% FS	20V, 0.3%+ .1% FS	20V, 0.3%+ .1% FS	20V, 0.3%+ .1% FS	20V, 0.3%+ .1% FS	20V, 0.3%+ .1% FS
Voltage Measure — Range 3	60V	150V	60V	60V	60V	60V
Current Measure — Range 1	2A, 1%+ 20mA	2A, 1%+ 20mA	5A, 1%+ 30mA	10A, 1%+ 50mA	20A, 1%+ 100mA	30A, 1%+ 200mA
Current Measure — Range 2	20A, 1%+ 50mA	20V, 1%+ 50mA	50A, 1%+ 100mA	100A, 1%+ 200mA	200A, 1%+ 400mA	300A, 1% + 600mA

MODEL

PARAMETER	SW2-20			SW2-20HV			SW2-50			SW2-100			SW2-200			SW2-300		
	Range	Full Scale	Acc.	Range	Full Scale	Acc.	Range	Full Scale	Acc.	Range	Full Scale	Acc.	Range	Full Scale	Acc.	Range	Full Scale	Acc.
Control Waveform (I Prog)	2A	5V	1%+ 50mV	2A	5V	1%+ 50mV	5A	5V	1%+ 50mV	10A	5V	1%+ 50mV	20A	5V	1%+ 50mV	30A	5V	1%+ 50mV
	20A	5V	1%+ 50mV	20A	5V	1%+ 50mV	50A	5V	1%+ 50mV	100A	5V	1%+ 50mV	200A	5V	1%+ 50mV	300A	5V	1%+ 50mV
	Range	Full Scale	Acc.	Range	Full Scale	Acc.	Range	Full Scale	Acc.	Range	Full Scale	Acc.	Range	Full Scale	Acc.	Range	Full Scale	Acc.
Current Waveform (I Meas)	2A	1V	1%+ 10mV	2A	1V	1%+ 10mV	5A	1V	1%+ 10mV	10A	1V	1%+ 10mV	20A	1V	1%+ 10mV	30A	1V	1%+ 10mV
	20A	1V	1%+ 10mV	20A	1V	1%+ 10mV	50A	1V	1%+ 10mV	100A	1V	1%+ 10mV	200A	1V	1%+ 10mV	300A	1V	1%+ 10mV

TABLE 2 (SPECIFICATIONS)

Notes:

1. High Current Level Duration must exceed the total time needed for the rise time of the programmed wave.
2. Low Current Level Duration must exceed the total time needed for the fall time of the programmed wave.

1.5 FUNCTIONAL CONTROLS, DISPLAYS, AND CONNECTIONS

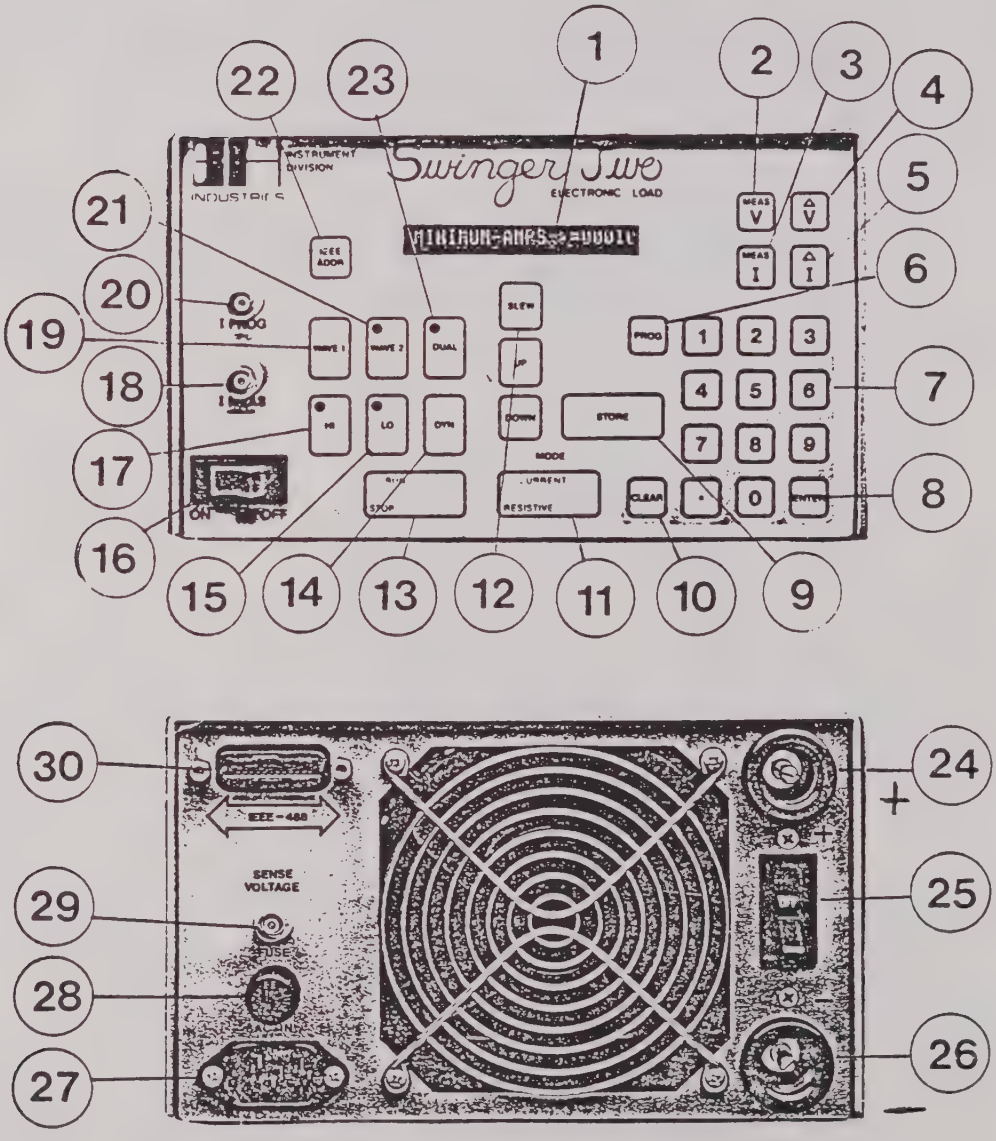


FIGURE 3

1.5 FUNCTIONAL CONTROLS, DISPLAYS, and CONNECTIONS
(See Figure 3)

ITEM	TITLE	FUNCTION
1	Alphanumeric display	This display gives the operator readings and prompts from the microprocessor.
2	Measure Voltage Key	This Key when pushed in the static load mode sends a reading to the alphanumeric display of the actual voltage of the UUT.
3	Measure Current Key	This Key when pushed in the static load mode sends a reading to the alphanumeric display of the actual current being loaded.
4	Delta Voltage Key	This Key when pushed in the dynamic load mode sends a reading to the alphanumeric display of the dynamic regulation of the UUT.
5	Delta Current Key	This Key when pushed in the dynamic load mode sends a reading to the alphanumeric display of the change of current of the UUT.
6	Program Key	This Key allows the user to alter through the numeric keys the parameters of Wave 1 or Wave 2 as well as the number of cycles of the Dual mode.
7	Numeric Keypad	The numeric keypad is used in the program mode to set the parameters of the waveforms or to enter the number of cycles for dual operation or to set the IEEE address.
8	Enter Key	This key is used to store the values that are entered from the numeric keys for each of the parameters of the waveforms or the number of cycles of the dual mode.
9	Store Key	This key is used to store all the input information of the waveforms, # of cycles in the dual mode or the IEEE address once the operator is satisfied and ready to run.
10	Clear Key	This key is used to clear any information from the input to the Swinger Two™ that the operator determines to be wrong. New information may then be keyed in.
11	Current/Resistive Mode Key	This key is used to input the information of the type of load that the user wants the Swinger Two™ to be: Constant Current(Green LED) or Constant Resistance (Red LED)
12	Slew Keypad	This key is used in the running mode so that the operator can vary the parameters of the waveforms via its associated keys (Up & Down) while the UUT is under load.
13	Run/Stop Key	This key makes the Swinger Two™ start to run(green LED) or stop (Red LED)

(See Figure 3)

ITEM	TITLE	FUNCTION
14	Dynamic Mode Key	This key determines the mode of operation of the Swinger Two™ to be dynamic.
15	Low Current Mode Key	This key sets the mode of operation of the Swinger Two™ to be Static low current.
16	On/Off Switch	This is the on/off switch.
17	High Current Mode Key	This key sets the mode of operation of the Swinger Two™ to be static high current.
18	I Measure Waveform Output	This is the output connector to look at the actual current loading waveform.
19	Wave 1 Mode Key	This key is used to put the Swinger Two™ on Wave 1 operation or programming.
20	I Programmed Wave Output	This is the output connector to look at the programmed waveform.
21	Wave 2 Mode Key	This key is used to put the Swinger Two™ on Wave 2 operation or programming.
22	IEEE Address Key	This key is used to check the IEEE address or to open the programming input for the IEEE address. It must be followed by depressing the Store Key.
23	Dual Mode Key	This key is used to put the Swinger Two™ in the Dual mode of operation or Dual programming mode.
24	Positive Load Connector	This is the connector for the positive terminal load hook-up to the UUT. (On the SW2-100, SW2-200, and SW2-300 this connection is on the front panel.)
25	Overload Circuit Breaker	This circuit breaker is part of the overload protection of the Swinger Two™. (On the SW2-100, SW2-200, and SW2-300 this circuit breaker is replaced by a fuse inside of the load)
26	Negative Load Connector	This is the connector for the negative terminal load hook-up to the UUT (On the SW2-100, SW2-200, and SW2-300 this connection is on the front panel.)
27	AC Power Input	This is the AC input connector to the Swinger Two™.
28	AC Input Fuse	This is the AC input fuse for the Swinger Two™.
29	Remote Sense Input	This connector is the remote voltage sense input to the Swinger Two™. (On the SW2-100, SW2-200, and SW2-300 this connection is on the front panel and the SW2-20 uses pin 4[-] and 9[+] of a 9-pin Amphenol connector (part #17-1587-01). Mating connector is Amphenol part# 17-10090.
30	IEEE 488 Input Connector	This is the input connector for the IEEE bus.

2.1 OPERATING INSTRUCTIONS

Turn on the power and you will quickly be able to put this state-of-the-art instrument to work. Connect the output of your supply to the input of the Swinger Two™ with the high level output connected to the RED Connector and the low level output to the BLACK Connector. The Sense Wires use the same logic. (See figure 4 for wiring hook-ups for positive and negative output supplies.)

The unit will automatically enter into a self-test routine to insure proper operation. You can now store two independant load waveforms for later recall. Choose either WAVE 1 or WAVE 2 by pressing the appropriate key and confirm the selection by observing that the appropriate yellow LED is lit. Now press the PROG key and follow the set-up procedure that is automatically scrolled on the unit's alphanumeric display.

The first scroll message asks for your desired operating mode-constant current or constant resistance. By pressing the CURRENT/RESISTIVE key and noting the color of the LED, you can enter the CURRENT mode (green LED) or RESISTIVE mode (red LED). Now press the ENTER key and your choice is entered. Next the alphanumeric display requests the expected voltage in order to optimize the accuracy of the voltage measurement by selecting the appropriate range. Use the numeric keys to select the value you desire. If you make an error, simply press the CLEAR key and select the correct value. Enter this value with the ENTER key.

The setup program will then guide you through all of the parameters required to specify the dynamic waveform. These include in the constant current mode low current level(MINIMUM AMPS), current rise time(AMPS/uSEC RISE), high current level(MAXIMUM AMPS), time for the high current to ramp up and remain high(MILLISEC HIGH), current fall rate(AMPS/uSEC FALL), and time to fall to and remain at the low current level(MILLISEC LOW). In the constant resistive mode the setup program will only differ at the point where it asks for current. In this mode it will ask you to put in the appropriate resistance that you desire the output of the supply to see.

As a helping prompt, the display will periodically flash the permitted range of values for that setting allowing in some cases some flexibility for overrange. You have now completely specified a dynamic waveform. To store it, simply press the STORE key and note that the LED turns red. In order to put in a second wave simply press the WAVE key that does not have its LED lighted and repeat the above procedure.

Although the previous description has emphasized the dynamic operation of the Swinger Two™, it can operate in the static mode as well. You may select this type of operation by simply pressing the HI or LO key and it will automatically take you to the appropriate level of current for the programmed level in the waveform that is selected at that time. After selecting either the dynamic or static mode of operation you initiate the operation of the load by pressing the run key and monitoring the LED for that key. If it goes green the load is in operation. If it remains red it is indicating that the load does not have a necessary programmed value for the particular type of operation that you are trying to do. Switching amoung the modes simply requires pressing the appropriate key-HI, LO, or DYN. A yellow LED on the respective key indicates the running mode. With the capability of storing two completely different waveforms, you can instantly access two completely different waveforms and four different static levels.

A very important point is that even in the static mode the load will get to that static level desired from the previous level at the slew rate defined in the parameters of the AMPS/uSEC RISE and AMPS/uSEC FALL for the waveform that is selected. This is important because even in the static mode the user has control of the slew rate. This makes Swinger Two™ truly universal since it accomodates the different supply requirements of rate of rise and fall for current loading.

The key labeled SLEW with UP and DOWN keys are used to vary any of the parameters of the current waveform while the load is running, just as if each and every one of the parameters was under a control knob. For example, if you wish to increase AMPS/uSEC RISE or decrease it while the load is being applied, simply push the SLEW key and press the ENTER key until the AMPS/uSEC parameter is displayed. Then push either the UP key or the DOWN key and see that value increment up or decrement down as the key remains depressed. This is all done while the load is being applied to the unit under test and allows you to see the effect of varying that parameter on the supply under test.

One of the advantages of the SLEW key is that the alphanumeric display will show the exact value of the parameter as it is being varied up or down. Successively striking the UP and DOWN keys causes the parameter value to vary in discrete steps instead of continuously.

The key labeled DUAL is used to allow the operator to alternate between WAVE 1 and WAVE 2 continuously. The user also enters the number of wave cycles of each wave to be applied while alternating from one to the other. This is done while the load is not running. First press the DUAL key and then the PROG key. The alphanumeric display will again scroll and ask the operator to enter the number of cycles of WAVE 1. Use the numeric keys to enter a value and then press the ENTER key to store that value. Now the alphanumeric display will ask the operator to enter the number of cycles for WAVE 2. Enter a value from the numeric keys and press the ENTER key to store that value. If you are satisfied with the input information then press the STORE key and you are ready to run.

The Swinger Two™ has two voltage measurement capabilities. The first one is for measuring the output voltage of the supply in the static mode of operation. This is normally done with remote sense. The user connects the remote sense input of the Swinger Two™ directly to the output of the supply at the output terminals. Now depress the key that is labeled MEAS V. The alphanumeric display will immediately display the results.

The second voltage measurement capability is measuring the dynamic regulation of the output of the supply. This is done in the dynamic mode of operation with the same hookup as above. Now depress the key labeled _ V. The voltage measure is syncronized to the dynamic load current waveform and makes a voltage measurement first at the low current voltage level just before it starts to rise to the high current level. It then takes another voltage measurement at the high current level just before it starts decrementing to the low current level and immediately the alphanumeric display reports the difference between the two voltage levels.

There are also two current measurement capabilities. The MEAS I key allows the user to verify the actual current being drawn in the static mode. This can be used to insure proper connection and proper loading or, in the case of a resistive load, to determine the current level being drawn in that mode. This can be very useful in determining the current limiting points on the units under test.

The _ I measurement key is used in the dynamic mode to insure that the load is actually drawing and varying the load between the two programmed levels. It must be understood that the measurement keys are actually reporting a measurement, not just the programmed values.

2.2 PROGRAMMING INSTRUCTIONS

IEEE GENERAL

The IEEE key is used to set the IEEE address or to display it. In order to set the address, press the IEEE, key then use the numeric keys to set the address to the desired number. Now press the ENTER key and the STORE key and the address will be set at that number until it is reset. It is important to note that each time the IEEE key is depressed the STORE key must be depressed to return to a operational mode. If preferred the address of the load may be set permanently at the factory on request.

IEEE Interrupts all come through channel 3 of the CTC. The interrupt register of the 8291 must be read to determine which type of interrupt is occuring. Interrupts currently enabled are:

-Byte-in If busy, abort previous command, else store character in input buffer. If it is the EOM character, move the messasge to a processing buffer and clear input buffer for next message. Set flag to begin processing.

-Byte-out If busy or no data to be sent, send a 'z', else send next character in output buffer

-Group Trigger Set a flag to do a measurement if group trigger enabled (XH) and measurement pending.

-Serial Pole Complete Reset SRQ bit of status

-Device Clear- Aborts current command and resets input buffer pointers.

** To optimize speed, the CTC IEEE channel will be disabled on EOM character recieved for every incoming message. It will be re-enabled on completion of processing. This will also eliminate the need for 2 buffers and the need to check for 'busy'.

IEEE COMMAND FORMAT

All commands are 2 characters long. Some are followed by 1 digit (SR, BT) and the wave parameter commands are followed by up to 5 ASCII decimal digits, including a decimal point(with the exception of the cycle commands where a decimal point is not allowed). Commands may be strung together up to 64 characters long including the terminators. No separators are allowed. (Spaces, commas, and nulls will be allowed anywhere and ignored.)

Swinger Two™ Commands

1. WA, WB — These commands set Wave A or Wave B for programming(LED set). Note that the front panel LED reflects the current wave set for programming, not the wave running.

2. WD — This command is the set up for programming dual cycles.

3. CI, CR — These commands change the mode of operation of the Swinger Two™ (constant current/constant resistance) of the wave set for programming. These commands are ignored if this wave is running. No errors are generated. It should be noted that if this command is ignored, subsequent wave parameter changes will apply to the now running mode.

4. VE — This command changes the voltage of the wave set for programming. It may be followed by up to 5 ASCII decimal digits which may include a decimal point. A SRQ error will be generated if running programmable wave, or if a bad value or bad format is entered or if set to edit dual wave operation.

5. LL, HL, RU, RD, TU, TD — These commands Change the various parameters of the wave being programmed (min amps or ohms, max ohms or amps, rampup rate, ramp down rate, time high, time low). They use the same format as the 'VE' command above. Here it is, however, ok to change the parameters if the wave is running. It will rerun the wave without going to zero unless there is a range change.

6. CA, CB — These commands set WAVE A or WAVE B number of cycles if the user is programming in the dual mode. They may be followed by up to 5 ASCII decimal digits with no decimal point allowed. SRQ error will be generated if bad value, bad format, or if not ready for dual programming.

7. GA, GB — These commands set either WAVE A or WAVE B for programming. If currently running that wave, re-run it with any new values, but do not go to zero unless there is a range change. If stopped, start running and go to zero first.

8. GD — This command sets the programming for running dual and tells it to run as GA, GB. SRQ error will be generated if bad wave values or if wave modes are not the same.

9. GO — This command will run whichever wave is being programmed (LED is on) . SRQ error will be generated if bad wave values or if wave modes are not the same when told to run dual.

10. ST — This command is an unconditional stop.

11. HI, LO, DY — These commands select wheather the swinger will be running as a static HI level, Static LO level or DYnamic load. The Swinger Two™ must be in the running mode.

12. RA, RH — These commands tell the Swinger Two™ to Auto Range or to lock in High range. If running, re-run in new range if RH.

13. XI, XH — These commands tell the Swinger Two™ to take immediate measurement or to hold for IEEE group trigger when the measurement is requested. No errors generated here.

14. BT1 — This command sets the bus message terminator to CRLF
BT2 — This command sets the bus message terminator to semicolon
BT5 — This command sets the bus message terminator to CRLF w/EOI
BT6 — This command sets the bus message terminator to semicolon w/EOI

15. (SR) — SR commands asserts SRQ under the following conditions. Note that SRQ is always asserted when an error occurs.

SR1 — Data Available
SR2 — Not busy, processing a command
SR4 — Waiting for a trigger

16. VN — This command returns the Swinger Two™ Software version number and date in 15 characters plus terminators

17. (MS) — These commands make measurement and return the result as 5 Ascii digits, including decimal point. Overrange errors return a result of 99999.

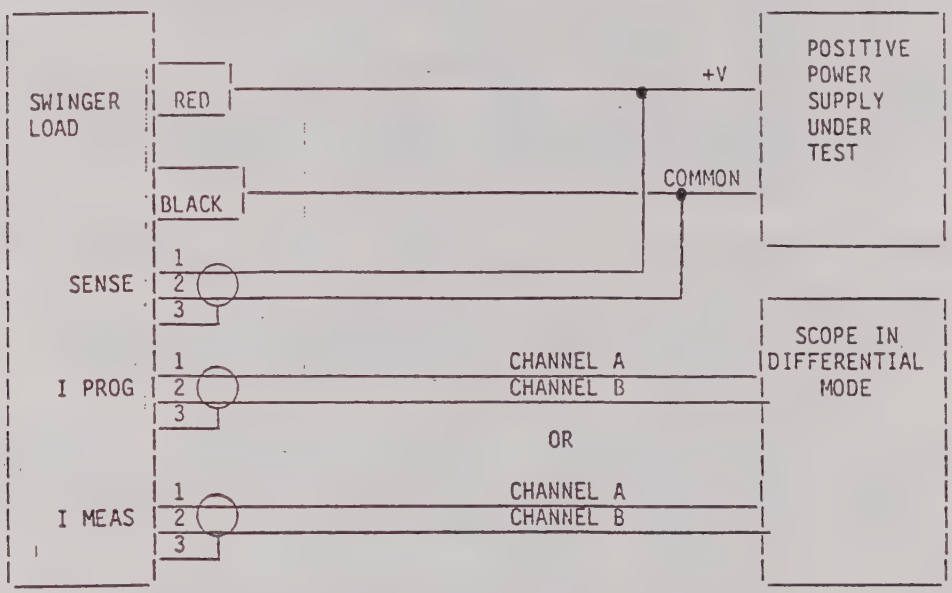
MS1 — Static Current(Valid measurement only in static mode)
MS2 — Delta Current (Valid measurement only in dynamic mode)
MS3 — Voltage (Valid measurement only in static mode)
MS4 — Delta Voltage (Valid measurement only in dynamic mode)

SERIAL POLL STATUS BYTE

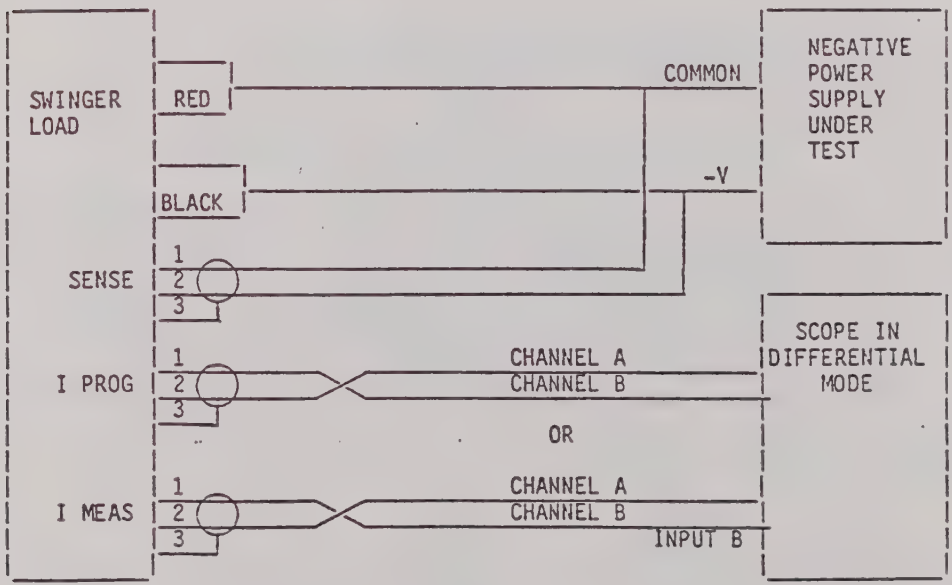
Error in command	Bit 7
I'm asserting SRQ	Bit 6
Crowbar condition	Bit 5
Over-range condition	Bit 4
Run/Stop	Bit 3
Requested Data Available	Bit 2
Command in Progress	Bit 1
Waiting for trigger	Bit 0

2.3 EXTERNAL CONNECTIONS FOR TESTING POSITIVE AND NEGATIVE POWER SUPPLIES

CONFIGURATION FOR TESTING POSITIVE POWER SUPPLY:



CONFIGURATION FOR TESTING NEGATIVE POWER SUPPLY:

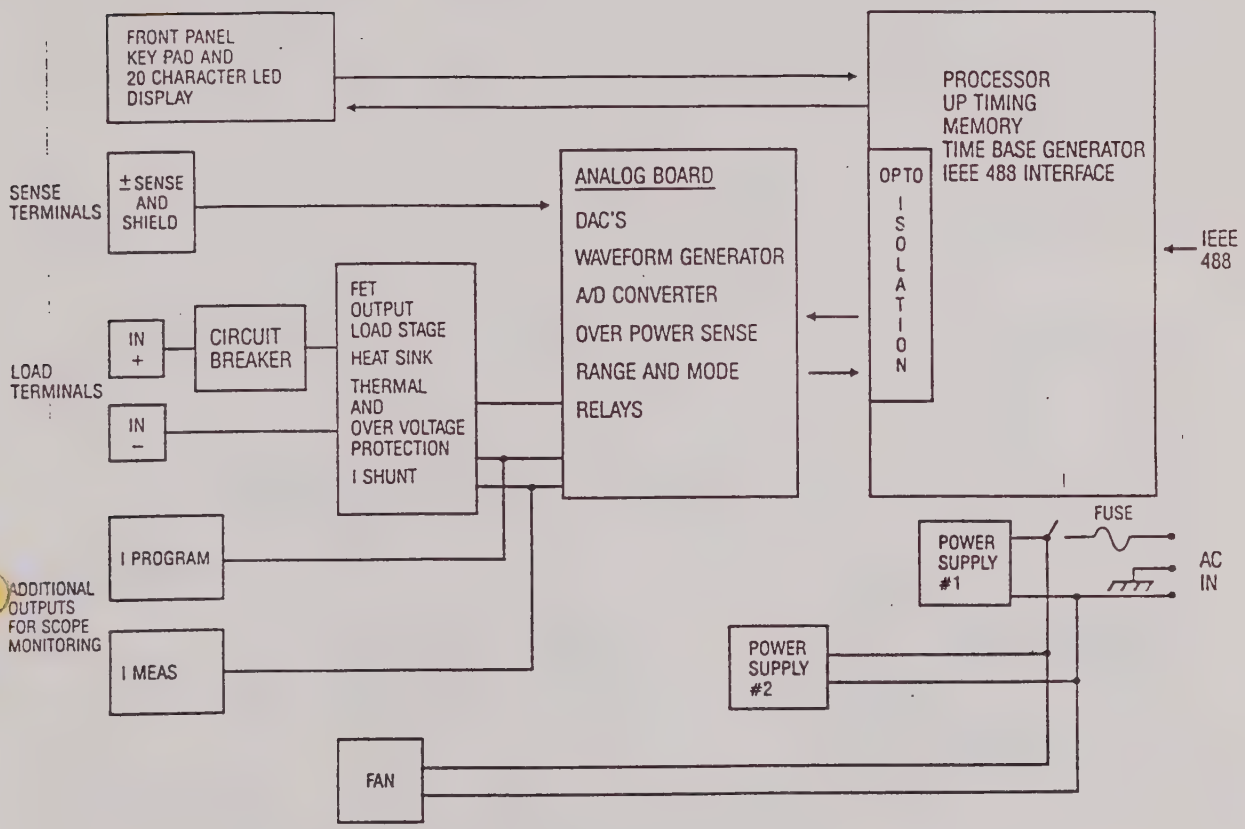


WARNING: Please note the connections for pins 1 and 2 when connecting I PROG or I MEAS up to a oscilloscope.

MATING CONNECTOR 3-H part# 290171-01 LEMO part# FEMOB303C0055

FIGURE 4

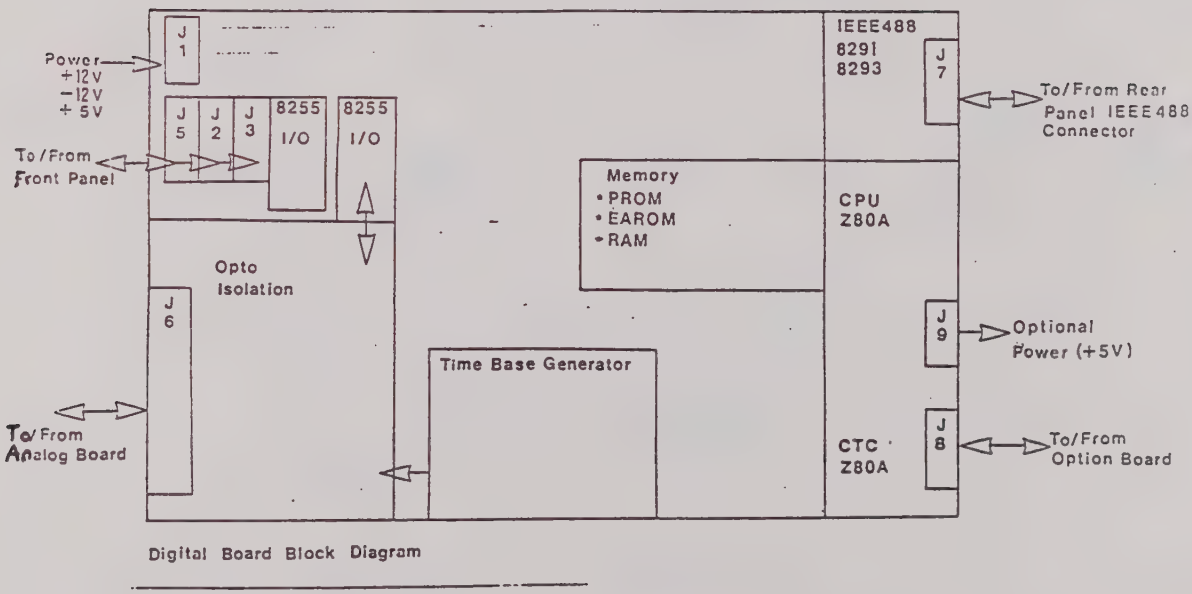
3.1 BLOCK DIAGRAM



SWINGER TWO BLOCK DIAGRAM

FIGURE 5

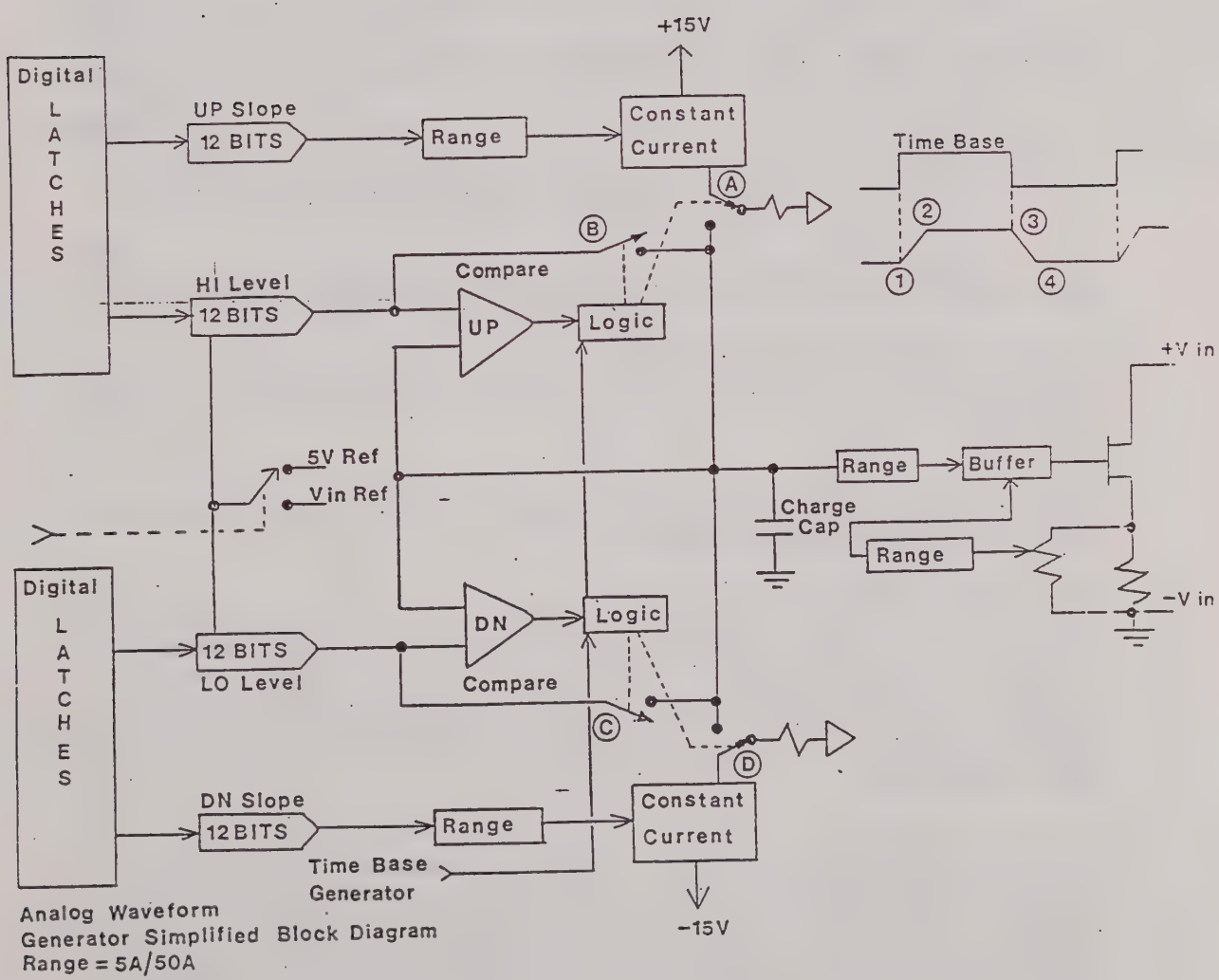
3.1 BLOCK DIAGRAM



Digital Board Block Diagram

FIGURE 6

3.1 BLOCK DIAGRAM



Analog Waveform
Generator Simplified Block Diagram
Range = 5A/50A

FIGURE 7

BLOCK DIAGRAM DESCRIPTION
(See Figure 6)

SWINGER TWO™ DIGITAL BOARD THEORY

The Swinger Two™ Digital Section is a Z280A based microprocessor system running at 4MHz. Its major functions include:

1. CPU and Memory
   While the two ROM sockets are strappable for 2K, 4K, 8K, or 16K Eproms, the system is presently using 2764 (8K x 8) type Eproms making program memory 16K x 8 in memory.
2. IEEE Addressing
   An EAROM (ZICON x 2816) 2K x 8 socket is provided for IEEE 488 addresses and certain system calibration constants.
3. System Variables
   A 2K x 8 static RAM is used for system variables.

Front Panel Communications are handeled as below:

1. A DECC model 520A vacuum flourescent 20 character display is the major system information source to the operator. It is used to display system prompts, status, measurements, waveform programming and system alarms.
2. A LED panel is used to display system mode information (run/stop, program/store, current/resistance mode, wave 1/wave 2/dual, hi/lo/dynamic.
3. A LEXAN pushbutton panel overlay provides the operator with a way to input information into the system. (See operating instructions.)

IEEE 488 COMMUNICATIONS (See Figure 5)

The INTEL 8291 talker/listener and 8293 bus transceivers comprise the IEEE 488 hardware. The system is interrupt driven via one channel of the Z80A counter/timer chip.

OPTION COMMUNICATIONS

A limited Z80 bus interface set is brought out to a connector for options which may be added to the Swinger Two™.

OPTO-ISOLATED INTERFACE (See Figure 5)

In order to accomodate positive and negative ground UUTs, two seperate power supplies are provided. Power Supply #1 provides power to the digital section and exterior communications. Power Supply #2 provides analog power to the waveform generator and measurement sections. The two sets of signals are optically isolated from each other to prevent equipment damage when testing a positive ground unit. Digital communications as well as time base signals are accommodated.

TIME BASE GENERATOR

The processor controlled time base generator provides a programmable TTL waveform that may take on several characteristics (pulses from 100uSec to 66.6mSec, rep rate of 10KHz to 15Hz, programmable pulse counts, resolution 500nSec, accuracy to ± 30nSec, programmed steady state of hi or low). The time base signals are provided to the analog section via high speed opto isolators.

3.1 BLOCK DIAGRAM DISCRIPTION (continued)
(see Figure 7)

DIGITAL WAVEFORM SWITCHING SEQUENCE

TIME 0
Assume that switch 'C' is closed and waveform is at level programmed by Lo Level DAC. Switches 'A', 'B' and 'D' are open.

TIME 1
Switch 'C' opens and switch 'A' closes. Waveform voltage starts to rise at the constant rate programmed by Up Slope DAC.

TIME 2
The up comparator determines that the voltage programmed by the Hi Level DAC has been reached and thus closes switch 'B' and opens switch 'A'. Waveform stays at the level programmed by High Level DAC until TIME 3.

TIME 3
The time base signal says that it is time to start back down so switch 'B' is opened and switch 'D' is closed. The waveform voltage starts to fall at the constant rate programmed by the Down Slope DAC.

TIME 4
The down comparator determines that the voltage programmed by the Low Level DAC has been reached, closes switch 'C' and opens switch 'D'. The voltage remains at low level until the cycle repeats.

3.2 CALIBRATION PROCEDURE

EQUIPMENT REQUIRED:
1. 100MHz oscilloscope (HP 1740A or equal)
2. 3 1/2 digit DMM (Fluke 8060a or equal)
3. DC Power supply capable of supplying full scale current of your model.
4. Current shunt (Max Swinger TWO™ Current = 100mV output)

*Note: All calibration is done in the constant current mode, and with the output of the power supply used for loading adjusted to 5 VDC at > full scale current of your model unless otherwise noted. The adjustments referred to in this procedure as A's are potentiometers. The Swinger Two™ must be removed from the case to do the calibration.

3.2.1 DAC OUT CALIBRATION

1. Turn on the power to the Swinger Two™
2. Attach DMM negative probe to signal ground. (J1,P6)
3. Press the PROG key
4. Set the program from the front panel of the Swinger Two™ to:
   A. Wave 1
   B. Min Amps = See calibration chart 3.2.1.4B for your model. SEE FIG 1d PAGE 5
   C. Amps/uSec Rise = See calibration chart 3.2.1.4C for your model. TABLE 2 PAGE 7
   D. Max Amps = See calibration chart 3.2.1.4D for your model. TABLE 2 PAGE 6
   E. Amps/uSec Fall = See calibration chart 3.2.1.4E for your model. TABLE 2 PAGE 7
5. Press the STORE key
6. Press the LO key
7. Press the RUN/STOP key for run mode
8. Place the DMM positive probe to TP1 and adjust A1 for -5.000 VDC
9. Place the DMM positive probe to TP2 and adjust A2 for +4.500 VDC
10. Place the DMM positive probe to TP3 and adjust A3 for +0.500 VDC
11. Place the DMM positive probe to TP4 and adjust A4 for +5.000 VDC
12. Press the RUN/STOP key to stop mode.

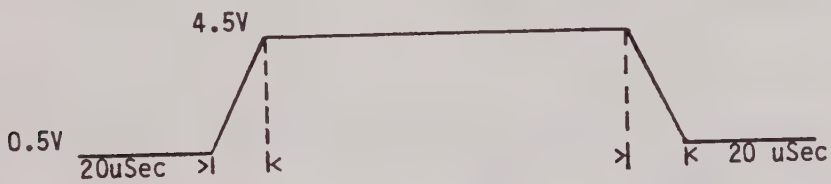
3.2.2 OVERSHOOT AND UNDERSHOOT CALIBRATION

1. Press the PROG key
2. Set the program from the front panel of the Swinger Two™ to:
   A. Min Amps = See calibration chart 3.2.2.2B for your model. FIG 1d PAGE 5
   B. Amps/uSec Rise = See calibration chart 3.2.2.2C for your model. TABLE 2 PAGE 7
   C. Max Amps = See calibration chart 3.2.2.2D for your model. TABLE 2 PAGE 6
   D. Amps/uSec Fall = See calibration chart 3.2.2.2E for your model. TABLE 2 PAGE 7
3. Press the STORE key
4. Press the DYN key
5. Press the RUN/STOP key for run mode
6. Set the Oscilloscope to 1VDC/cm. vertical expansion and and a horizontal expansion of 1mSec/cm. using external sync. from U21-1
7. Place input probe to U23-6 and observe the waveform.
8. Adjust A12 for minimum overshoot with no oscillation
9. Adjust A13 for minimum undershoot with no oscillation
10. Press the RUN/STOP key to stop mode.

3.2 CALIBRATION PROCEDURE (continued)

3.2.3 RISE AND FALL CALIBRATION, HIGH RANGE

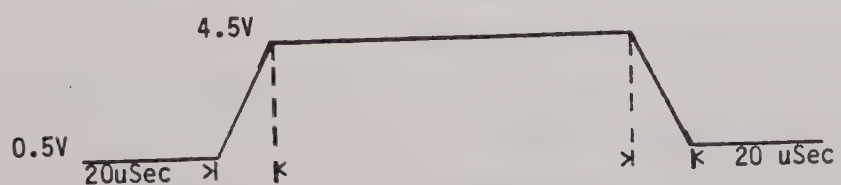
1. Press the PROG key
2. Set the program from the front panel of the Swinger Two™ to:
   A. Min Amps = See calibration chart 3.2.3.2B for your model. Field page 5 ~~TABLE 2 PAGE~~
   B. Amps/uSec Rise = See calibration chart 3.2.3.2C for your model. TABLE 2 PAGE 7
   C. Max Amps = See calibration chart 3.2.3.2D for your model. TABLE 2 PAGE 6
   D. Amps/uSec Fall = See calibration chart 3.2.3.2E for your model. TABLE 2 PAGE 7
3. Press the STORE key
4. Press the DYN key
5. Press the RUN/STOP key for run mode
6. Set the Oscilloscope to 1VDC/cm. vertical expansion and and a horizontal expansion of 1mSec/cm. using external sync. from U21-1
7. Place input probe to U23-6 and observe the waveform.



8. Adjust A8 for 20 uSec.
9. Adjust A10 for 20 uSec.
10. Press the RUN/STOP key to stop mode.

3.2.4 RISE AND FALL CALIBRATION, LOW RANGE

1. Press the PROG key
2. Set the program from the front panel of the Swinger Two™ to:
   A. Min Amps = See calibration chart 3.2.4.2B for your model.
   B. Amps/uSec Rise = See calibration chart 3.2.4.2C for your model.
   C. Max Amps = See calibration chart 3.2.4.2D for your model.
   D. Amps/uSec Fall = See calibration chart 3.2.4.2E for your model.
3. Press the STORE key
4. Press the DYN key
5. Press the RUN/STOP key for run mode
6. Set the Oscilloscope to 1VDC/cm. vertical expansion and and a horizontal expansion of 1mSec/cm. using external sync. from U21-1
7. Place input probe to U23-6 and observe the waveform.



8. Adjust A8 for 20 uSec.
9. Adjust A10 for 20 uSec.
10. Press the RUN/STOP key to stop mode.

3.2.5 PROGRAMMED OUTPUT ZERO CALIBRATION

1. Attach DMM negative probe to signal ground. (J1,P6)
2. Press the PROG key
3. Set the program from the front panel of the Swinger Two™ to:
   A. Wave 1
   B. Min Amps = See calibration chart 3.2.5.3B for your model.
4. Press the STORE key
5. Press the LO key
6. Press the RUN/STOP key for run mode
7. Place the DMM positive probe to Junction of A19-2 and R97
8. Adjust A19 for approximately +0.2 VDC
9. Place the DMM positive probe to U34-3 being careful not to short pin 3 to pin 4.
10. Adjust A19 for 0.001 VDC
11. Press the RUN/STOP key to stop mode.

3.2.6 FEEDBACK ZERO CALIBRATION

1. Set up the program of the Swinger Two™ as in Paragraph 3.2.5 steps 1-6.
2. Place the DMM positive probe to TP6
3. Adjust A16 for -0.050 VDC $\pm$ 0.2 mVDC
4. Press the RUN/STOP key to stop mode.

3.2.7 FEED BACK MEASURE SCALING CALIBRATION

1. Place the shunt in the current sinking line of the Swinger Two™.
2. Press the PROG key
3. Set the program from the front panel of the Swinger Two™ to:
   A. Wave 1
   B. Max Amps = See calibration chart 3.2.7.3B for your model.
4. Press the STORE key
5. Press the HI key
6. Press the RUN/STOP key for run mode
7. Attach DMM negative probe to signal ground. (J1,P6)
8. Place the DMM positive probe to TP6 and record the voltage. It should be approximately -4.9VDC.
9. Place the DMM across the shunt in the mV range.
10. Adjust A14 for -0.002 times the value recorded in step 3.2.7.8.
11. Press the RUN/STOP key to stop mode.

3.2.8 LOW RANGE CURRENT SCALING CALIBRATION

1. Set up the program of the Swinger Two™ as in Paragraph 3.2.7 steps 1-6.
2. Place the DMM across the shunt.
3. Adjust A17 for 9.8 mVDC.
4. Press the RUN/STOP key to stop mode.

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